AL. 1.1066

December 1992 Volume 4, Number 3

Alberta TRANSPORTATION AND UTILITIES

TRANSPORTATION RESEARCH TRANSEARCH

A RESEARCH AND DEVELOPMENT TECHNICAL PUBLICATION

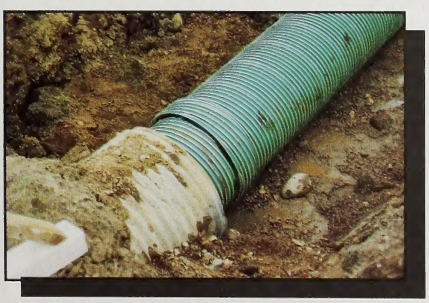
CANADIANA

DEC 15 1992

New Approach to Aging Problems

By Zach Zacharia, Research & Development
Peter Balko, Design Engineering

As our existing infrastructure ages, there is a greater emphasis on maintenance. Corrugated steel pipe (CSP) and Woodstave pipe (WSP) culverts can deteriorate as they age leading to potential failure. Removing and replacing these old culverts using the open cut method is very expensive. Usually the Highway has to be closed or an expensive detour has to be constructed. The augering method of replacing a culvert is not as disruptive but still can be costly (in the order of $800 per meter). A new approach involves inserting a smooth plastic liner installation of smaller diameter into the existing culvert. The smooth plastic liner costs approximately $225 per meter which is a fraction of the cost of the replacement methods identified earlier. Design Engineering branch indicated using a smaller diameter plastic liner will still allow the same flow capacity since the coefficient of friction of the liner is less than that of the corrugated steel pipe.



Plastic liner being inserted into steel culvert

The concept of using plastic liners has been successful, however there have been some minor problems with the grout that is used to fill the void between the liner and the existing culvert. Grout normally consists of a standard cement slurry mixture which is pre-mixed at a concrete plant and delivered using concrete trucks. This grout has a tendency to lift the liner which in many cases would not be acceptable. One possible solution was to use a brace to position the liner and prevent it from floating.

Completed Plastic Pipe Culvert Installation

A better solution uses a mixture which can be field mixed and the specific gravity can be adjusted through the addition of "Elastizell" a foaming agent. As Elastizell is added the batch mix is monitored to maintain a desired density. The resultant grout mixture attains a 28 day strength of 1.0 - 1.38 MPA (150 - 200 psi) which is acceptable. The mix is referred to as Elastizell EF (Engineered Fill) and because of its light weight has potential for many other engineering applications. The other desirable feature of the Elastizell EF mix is that all the materials and necessary equipment are easily transported to the culvert site.

Design Engineering has been involved in over 70 culvert liner installations and are quite willing to do more. If you would like further information on the use of plastic pipe as liners or as culverts, please contact Peter Balko or Joe Filice at 427-2087. Further information on the Department's first experience with plastic liners during the summer of 1989 can be found in the April/90 issue of Transearch.

IN THIS ISSUE

Aging Problems	1
Editorial - SHRP Products	2
Origin Destination Surveys	3
Pen-Based Computers	3
Log Turning Acceleration Study	4
Recycled Plastic Post Update	5
Bumpy Bridge Approaches	6
Guide Post Installation	6
All Rocks Are Not Created Equal - Aggregates	7
Expert Systems Successful	8

INSIDE - MORE RESEARCH UPDATES

About This Publication

The TRANSEARCH quarterly publication is prepared by the Research and Development Branch of Alberta Transportation and Utilities. The publication is dedicated to the effective transfer of transportation and utilities related research information and state-of-the art technologies throughout the department. The opinions expressed in the articles in this publication are those of the authors and are not necessarily the official views of Alberta Transportation and Utilities.

In short news and feature articles, TRANSEARCH reports on the most interesting research and technologically significant events concerning the department.

In the interest of providing a vehicle for the effective transfer of technology throughout the department, Research and Development encourages department staff to provide proposals containing unique ideas, innovations or opportunities for research and evaluation which may provide solutions to the various technical needs of the department.

This publication is distributed throughout the department of Alberta Transportation and Utilities. Back issues are catalogued and retained in the department library. Copies of TRANSEARCH are also distributed to other Canadian D.O.T.s as well as Alberta Cities.

Comments and suggestions may be submitted to:

Ray Filipiak, P.Eng. - Editor
TRANSEARCH

Research & Development Branch
Alberta Transportation & Utilities
1st Floor, Twin Atria Building
4999-98 Avenue
Edmonton, Alberta, T6B 2X3
Phone: (403) 422-2750

Printed on recycled paper

EDITORIAL

SHRP Products Now Available

There has been in the past much talk about the various products coming out of the C-SHRP and SHRP programs. This publication even dedicated an entire issue (April '92 Issue) to "SHRP Work Zone Safety Devices". There have been exhibitions of many prototype products or devices down in the States since the first major showing of these products at the AASHTO TECHNOLOGY TRANSFER FAIR in 1991.

Inquiries regarding acquisition of these products from department staff and from other provincial local road authorities are starting to roll into R&D branch. Unfortunately many of the products are not at the mass production stage just as yet. However, they will be soon and some are already available.

Research and Development branch intends to purchase some of these devices in the near future. We'll be sending them out to the various districts and asking them to help us evaluate the products.

We would also ask AT&U staff, especially those in the field to review the April '92 issue of TRANSEARCH and seriously consider for which products they may have a potential application. Having done that you can contact your district Technology Transfer Representative or R&D Branch (TEL: 422-2750) for more information and assistance in acquiring the product.

PRODUCT / DEVICE

1. Ultrasonic Detection Alarm
2. Infrared Intrusion Alarm
3. Queue Length Detector
4. Flashing STOP/ SLOW Paddle
5. Portable Speed Bump
6. Opposing Traffic Lane Divider
7. Remote Driven Vehicle
8. Salt Spreader Truck Mounted Attenuator (TMA)
9. Portable Crash Cushion

3rd ANNUAL

Research & Development Technology Transfer WORKSHOP

January 20-21, 1993

Red Deer Lodge
4311-49th Avenue
Red Deer, Alberta

For more information, please contact Ray Filipiak at (403)422-2750

NEW TECHNOLOGIES

Origin Destination Surveys

By Peter Kilburn, Technical Service Planning

The major cities of Alberta generate traffic volumes which far exceed levels at which it is safe and economical to survey motorists using the traditional roadside interview. Considering that the major urban areas also generate the highest demand for highway infrastructure the problem arises of how does the department obtain origin destination data, necessary for its planning and design work, on high volume roads at a reasonable cost and minimal disruption to the travelling public.

The problem is best illustrated by imagining a road block on Hwy. 2 south of Edmonton near Gateway Park. Approximately 17,000 vehicles travel southbound alone on this highway between 7 a.m. to 7 p.m. daily. At approximately 30 seconds per interview it would be impossible to survey this highway without major queuing and delays occurring.

The solution to this problem is seen in mailing out questionnaires addressed to the owners of vehicles passing by the survey sites using the licence plate numbers observed. The critical constraint in undertaking such a program is that the questionnaires must be mailed out and received by the vehicle owners within a few days of them passing through the survey site. Several technologies make this possible. Utilization of pen computers which allow direct input of licence plate numbers into a computer file can all but eliminate the need for paper tally sheets. Once the licence plate numbers are collected they can be readily matched to a vehicle registration file to produce a mailing list. The mailing list would contain the address of the licence owner, the location he passed through and the time he passed through. This information file can be transferred to Canada Post (or a mass mailing company) to generate electronic mailings. It is hoped for a 24 hour observation to mail out time.

This system is currently in use in Ontario without the "high tech" data entry and electronic mail out system. The Ontario Ministry of Transportation reports a 30 percent response rate to their mail outs for typical weekday surveys. In the context of the high traffic volumes which exist at the roads they survey this return provides them with statistically reliable information.

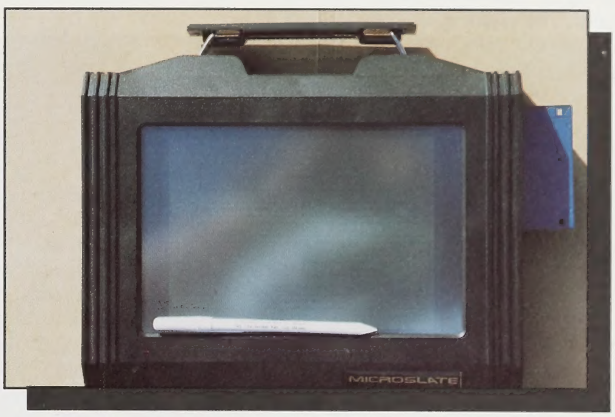
Presently all aspects of the system are in development and Traffic Data Systems is planning a test of the technique using a recently completed roadside survey site as a comparison. For more information on this topic you are invited to contact the author at 427-6720.

Pen-Based Computers

By Robert Powers, Research & Development

As the name implies pen-based computers allow a person to interact with a computer using a pen and a touch sensitive LCD rather than with a keyboard or mouse. As you can imagine this technology has the potential to open the door to computing not only for people who are uncomfortable with using a keyboard but also for data intensive applications where a keyboard would be unsuitable or too cumbersome.

The R&D branch is currently evaluating the potential of pen-based computer technology for use in data collection activities. With support from the Bridge Engineering and Technical Services branches two pilot projects have been initiated which are 1) bridge inspection data collection and 2) traffic data collection. These two pilot projects will evaluate a pen-based computer on factors such as general hardware and software performance, ease of use, environmental ruggedness, and cost effectiveness.



Microslate 386/25 Pen-Based Computer

The bridge inspection and traffic data collection pilot projects are intended to enhance the data collection and entry procedures currently being used to update the existing bridge and traffic information systems. Both of these systems rely on data collected on paper forms which is subsequently entered into the appropriate information system. Using the pen-based computer and specialized software the user will enter data directly into the computer using digitized forms and be able to download the information, by modem or direct connection, into a particular information system, thereby eliminating the need to keypunch the data into the information system.

Both bridge inspection and traffic data collection pilot projects are scheduled to be completed by March 31, 1993. If you would like additional information on either of the pilot projects contact Robert Powers at 422-2750.

Log Truck Turning and Acceleration Study

By Bill Kenny, Design Engineering
Allan Lo, Research & Development

Log trucks, wider and longer than conventional highway transport trucks and using special configurations only allowed in the log haul industry, can cause operational and safety problems at typical intersections. Most of these trucks are 3.2 m wide, up to 30.5 m long and carry logs with a maximum 9.0 m overhang. This overhang can become a potential hazard to both following and oncoming vehicles when log trucks make a left or right turn, and the rear logs swing out into the adjacent lanes. The extent of this encroachment outside of the vehicle wheel path is termed the "rear log sweep" (see figure 1).

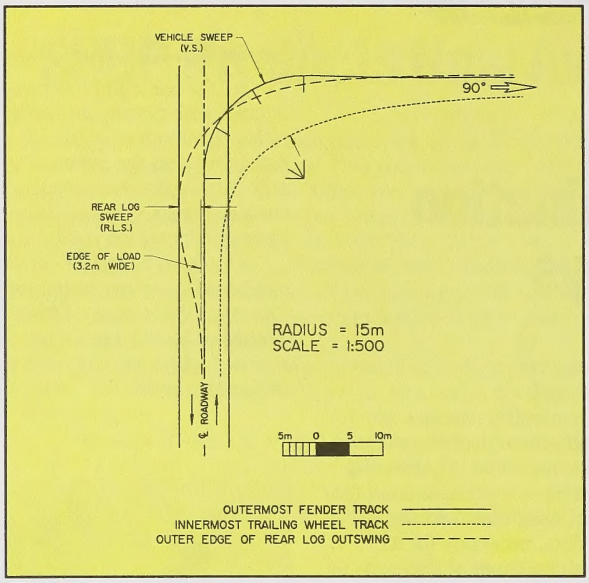


Figure 1

Standard design manuals do not have information on how to design for this sweep envelope. Moreover, the log truck wheel path cannot be assumed to follow that of the WB-15 Design Vehicle template because of the differences in the articulations and in the compensating reach mechanism employed in the log truck pole trailer design. Lastly, there are some questions regarding the acceleration capabilities of the log trucks because they are legally permitted to carry up to 65 000 kg GVW (winter weights on our highway system) as compared to the normal allowable of 56 100 kg. Intersection sight distances would be greatly impacted upon if the acceleration performance is found to be degraded significantly by the extra weight.

Drawing on a previous study done by Reid Crowther & Partners, Design Engineering hired a consultant, Felix Jesualexander, to carry out more in-depth investigations on two design aspects: one, to develop new turning templates for a "design" log truck; two, to compare the acceleration performance of the log trucks with the current WB-15 design curve. In order to accomplish the first goal, the consultant was asked to evaluate several off-the-shelf computer simulation programs for offtracking, and verify the results against previous field tests in the Reid Crowther report. PATH TRACKER, a program developed by the British Columbia Ministry of Transportation and Highways, was found to be the most accurate, most flexible in defining vehicular parameters, and friendly to use. Subsequently, this program was used to produce all final template results.

An integral part of the project was the new batch of field testings to be carried out by Design Engineering staff under the guidance of the consultant. The tests were accomplished in 2.5 days this past June using actual log haul equipment at the Weyerhaeuser yard in Drayton Valley. Here are some highlights:

1. Acceleration Tests - Three different trucks were used; they had GVW's of 67 260 kg, 55 700 kg, 53 710 kg, and engine horsepower of 400, 400, 350, respectively. Using stopwatches at 10 m intervals from 0 to 100 m, the time to reach each 10 m point was recorded. The data was later plotted as an "acceleration time" versus "distance travelled" curve.

2. Turning Tests - Three turning paths of 15 m, 25 m, 50 m, radius were laid out, each with exit angles of 30°, 60°, 90°, 120°, 150°, 180°. Five different truck/trailer configurations were compared directly in the 25 m radius 90° turn, but the main test truck (see figure 2- tandem jeep/pole trailer) was used throughout the test. Additionally, the sweep paths were measured for three overhang values of 4.5 m, 6.0 m and 9.0 m.

An interesting part of the field testing was to figure out how to measure the various sweep paths. Several Design Engineering staff were assigned to follow the truck as it turned, and lay down coloured bean bags on the ground every 3 metres to mark the paths the overhanging logs made (see photo). Then, a Total Station survey was carried out to record the positions of all the bags. The plots were later generated in the office using the EMXS program on a Microstation. A short demonstration video tape is being assembled from this exercise.

The results show that of all the trucks tested, the tandem jeep/pole trailer with the 9.0 m overhang had the worst log outsweep at 3.5 m for a 15 m radius 90° turn. The outsweep was

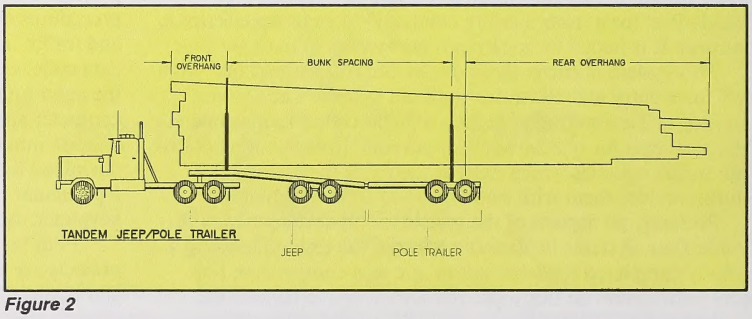


Figure 2

reduced to 1.8 m and 1.0 m for 6.0 m and 4.5 m overhang, respectively. On the other hand, the flatbed trailer (hayrack) produced the worst offtracking in vehicle sweep paths. Using the PATH TRACKER program, design turning templates will be created by combining the worst log sweep produced by the jeep truck with the worst offtracking path made by the flatbed truck.

The acceleration performance was determined to be comparable to the WB-15 design values. Assuming a 50 m travel distance, a fully loaded log truck would need about 15 seconds to clear an intersection.

This project has been a very successful collaboration between the industry and the government. A report has been drafted up, with the final revisions to be completed by the end of September, 1992. When it becomes available for public distribution, please contact Bill Kenny, Design Engineering branch, 4999-98 Avenue, Edmonton, Alberta, T6B 2X3 or call (403)427-3112.

Marking bags dropped at regular intervals

Recycled Plastic Post Update

By Peter Ing, Research & Development

In the last issue of TRANSEARCH, AT&U had indicated that several construction contracts will be using recycled plastic fence posts as an alternative to the conventional wood posts. Following is an update of their progress.

There are currently a number of these fencing projects completed around the province. These projects can be seen on Hwy. 5:02, west of Cardston, Hwy. 2:08, south of Claresholm, Hwy. 21:22, south of Ferintosh, Hwy. 53:06, east of Rimbey, L.R.I.D. 14 (Smicelski Rd.), north of Mckay. The Forestry department has also fenced grazing reserves in the St. Paul area with the recycled plastic posts. A few other projects are scheduled for the 1993 construction season.

Initial response to the plastic material was mixed but generally positive. The plastic fence posts were found to be acceptable in visual appearance. Black and grey posts are being produced and other colours are available on request. Installation was a little more difficult due to the flexible nature of plastic, particularly in dry hard ground conditions. Once installed, the few slight jogs on the fence alignment were not noticeable from the highway perspective. In locations susceptible to high moisture, though, the plastic fence posts should outlast their conventional wood counterparts.

A guardrail project on Hwy. 16, using recycled plastic posts, near Nojack was completed in September '92. This guardrail system was installed by the same method as conventional wood posts and is expected to function in the same manner. In terms of handling, there was no difficulty or any extra time involved. The I-beam shape posts were easier to grip during installation. See photograph.

Long term performance of recycled plastic posts still needs to be evaluated, particularly over seasonal heat/frost cycles. There is some concern that the plastic posts may creep or become brittle when exposed to extreme temperatures. However, from the completed projects, there has been no indication of any problem after one summer operation.

As a reminder, the department still has over 5,000 plastic fence posts stockpiled in CSF Edmonton. Anyone wishing to try the plastic posts or knows of any project that can benefit from them are encouraged to contact Joe Felice (DEB) or the shop directly. Design Engineering branch can help coordinate the set up of any potential projects. For more information on this program, please contact Peter Balko or Joe Felice (DEB) at 427-3112 or Peter Ing (R&D) at 422-2750.

Plastic guardrail post installation on hwy 16, east of jct. SH 753

INNOVATIVE IDEAS

Bumpy Bridge Approaches

Jack Stonehouse, Project Service Technologist from Medicine Hat has a problem. Every time he drives onto a bridge he hits a bump. How can we eliminate this bump?

Jack came up with a novel idea after seeing what a CPR crew did on a railway crossing. They used rubber planking as seen in the photograph. Are there other solutions to the "bump" problem? Is the bump always inevitable considering the approach is made up of fill which will settle and the bridge is structurally stable?

Last issue we asked about solutions to the problems of lumps on the Hopper Sander Grizzly. Only one new suggestion has come in so far which indicated that the loader operator should first use the bucket to flatten any lumps before putting it in the hopper. Any other solutions to the grizzly lump problem?

Please send possible solutions and any other commonly recurring (work related) problems to Zach Zacharia c/o Research & Development branch or phone 422-2750.

Rubber planking in railway crossing

Guide Post Installation

By Terry Colosimo
Resident Enginneer, Lac La Biche

The Bonnyville maintenance staff from the Lac La Biche District have a innovative installation method for the guide posts in their area.

The initiative arose when it was found that vandals would drive along the highway and pull out the guide posts. Although the guide post were not usually stolen, they would have to be reinstalled on a weekly basis.

The Bonnyville maintenance foreman, Malcolm McFayden decided to modify the guide post so that it would make it nearly impossible to manually remove the post from the ground.

A 1/2" hole was drilled perpendicular through the guide post approximately six inches from the bottom. A one foot piece of 1/2" cable (usually used grader snow wing lift cable) was placed through the guide post so that equal amounts of cable were protruding on either side of the post.

The guide post was then pushed into a hand-augered four inch diameter hole

Keith Davis, Bonnyville foreman holding guide post

causing the extended cable to bend upwards along the guide post. When it was attempted to remove the post the cable would give resistance against the soil preventing the post from being removed.

Mr. McFayden also uses an eight inch spike instead of the cable, but a six inch hole must be drilled as the spike does not bend. The hole is drilled using a power auger. Earthen material must then be tamped around the post to make up the difference in diameter between the hole and pipe.

This spike method is less work intensive as the hole is machine augered, the one foot cables do not have to be cut and the spikes can be purchased at a minimal cost. The six inch augered hole with the spike modification works best in soil cement as it is too hard to hand auger a four inch hole in this type of material. The modification can also be used for sign posts if required.

Both methods are very successful in deterring vandals from removing the guide posts along our highways. Thanks Malcolm for this innovative idea.

All Rocks Are Not Created Equal

By Alan Mah, Research & Development

Crushed rocks or in technical terms, "aggregates" are used extensively in highway construction. The strong physical properties of most aggregates makes them an important building material in the construction industry.

As not all aggregates have the same physical characteristics, it is important to determine which aggregates are acceptable for a given application, ie. concrete structures or asphalt pavements. For example, using unsuitable aggregates for a structural concrete will significantly reduce the expected service life of a bridge structure or may even result in structural failure.

One of the test methods used to determine aggregate quality is called petrographic analysis. Petrographic analysis is a qualitative examination of each rock type within an aggregate sample. The results of the petrographic analysis are used to derive a Petrographic Number (PN). Although this sounds simple, it is far from it.

The PN is usually assigned by a professional geologist after a series of simple tests and a visual examination to determine the type and strength of the rocks in the sample and weighing the amount of each rock type present. The assumptions inherent in the petrographic analysis to determine the PN are:

1) various rock types have particular durability, strength and hardness, that equates to "quality". Difficulty exists because even the same rock types can vary by region depending on weathering history, cementation process, etc.;

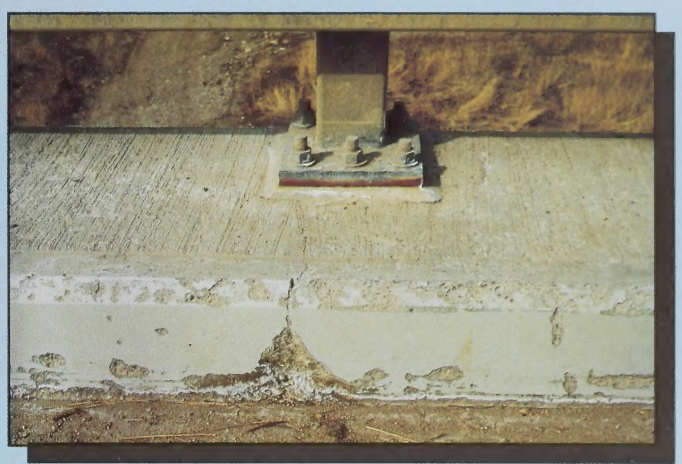
2) the geologist can identify all rock types and their quantity in the aggregate sample; and

3) a standard quality value can be attributed to each rock type to establish a quality value (petrographic number) for the aggregate sample.

Other "quality modifiers" like degree of porosity or encrustation is much harder to determine, but can greatly influence durability. Some of these call for individual judgement and may increase the difficulty of arriving at comparable results.

The petrographic procedure used in Alberta was adapted from Ontario and was found to be not representative of Alberta aggregates. The local testing laboratories have realized this and made some adjustments to the Ontario test method to be more suitable to describe our local aggregates. Unfortunately, as each laboratory developed their own "modified test", the results among testing laboratories became inconsistent.

A simple demonstration conducted in 1991 illustrated that sample aggregates from the same source yielded, petrographic numbers of 115 and 143 when tested by two different laboratories. Even considering the variability in the samples themselves, this large difference in PN places the aggregate into an excellent or fair category depending on who conducted the test. In more serious cases, the same aggregate could be accepted or rejected depending on the testing laboratory used. When Alberta Transportation & Utilities discovered the problem, it was decided to proceed with the development of an Alberta based petrographic test procedure that would address local aggregates and be the standard for all laboratories conducting the petrographic analysis. The resulting project was awarded to the Geological Survey Section of the Alberta Research Council in the summer of 1992.



Deteriorating Concrete Curb

On the completion of the project, a seminar is planned for all potential users to ensure that the new test procedures are understood and correctly applied. This work is scheduled for completion by the spring of 1993, and will be implemented for the 1993 construction season.

An Alberta based petrographic analysis would result in more consistent and reliable assessment of aggregate quality.

Expert Systems

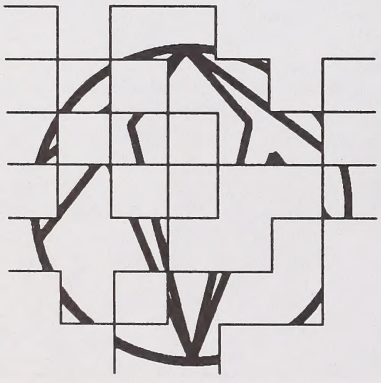
Successful at TAC Conference

By Jan Konarzewski, Research & Development

In an effort to promote technology transfer at the national level, Zach Zacharia of the Research & Development Branch made a presentation on Expert Systems at the Research and Development Council's Session of the Transportation Association of Canada's conference in Quebec City.

The presentation consisted of our own experience in developing an inexpensive strategy for implementation of expert systems and incorporated a demonstration of our bridge painting and culvert repair expert systems and distribution of

> *...gave audience the opportunity to "take it home to see how it really feels"*

run time software to interested parties. Judging by the reaction of the audience and the number of diskettes and papers we gave away, in the future expert systems may be popping up all over the place. Distribution of the diskettes gave the audience the opportunity to "take it home to see how it really feels".

Back here at home, the infusion of expert systems into the department has started its final phase. A three day course was held in October with fourteen participants, four from the regions, the rest from head office. At the time of writing, Contract's Engineering Branch has committed itself to expert systems development, Design Engineering and Region 6 have very serious intentions to develop, and several others have expressed interest.